

Zero Retries issue 0143 2024-03-15

Zero Retries is an independent newsletter promoting technological innovation that is occurring in Amateur Radio, and Amateur Radio as (literally) a license to experiment with and learn about radio technology. Now in its third year of publication, with ~~1300~~ 1400+ (!!!) subscribers.

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Steve Stroh N8GNJ, Editor

Jack Stroh, Late Night Assistant Editor Emeritus

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Web version of this issue - <https://www.zeroretries.org/p/zero-retries-0143>

Request To Send

Commentary by Editor Steve Stroh N8GNJ

Zero Retries Subscriber Count - 1400+

Thanks largely to a very nice mention of my **Zero Retries 0142** article - At Peace with Amateur Radio Over Internet in [Amateur Radio Weekly Issue 322](#), the Zero Retries subscriber count very rapidly ticked up to more than 1400 subscribers.

Zero Retries was also recently recommended in two Substack Amateur Radio newsletters, which also contributed to the bump in subscribers:



[EI7GL Amateur Radio Newsletter](#)

[Amateur Radio News with an emphasis on radio experiments & the VHF bands](#)

[By John Desmond](#)

EI7GL's newsletter is brand new! Welcome EI7GL to "Amateur Radio Substacking".



[73 from G5DOC](#)

[A radio related email from G5DOC](#)
[By Documentally](#)

Subscribe

I've been following "73 from G5DOC" for some time, and enjoy G5DOC's content.

Thanks EI7GL and G5DOC for your recommendations of Zero Retries!

It's irritating that Substack allows only a maximum of three "blurbs" to be displayed; I'll try to rotate my "blurbs" to accommodate the Amateur Radio Setback newsletters that publish public (not excessively paywalled) content.

Large Amateur Radio Conferences Countdowns

Just keeping track of (US) Hamvention is probably a bit parochial, though there's ample international attendance. Thus I'm broadening this countdown to the "big three" Amateur Radio conferences. I think that the big 2024 Amateur Radio conferences will have some interesting announcements.

- [Hamvention 2024](#) in Xenia, Ohio, USA on 2024-05-17 thru 19, in 09 weeks!
- [HAM RADIO 2024](#) in Friedrichshafen, Germany on 2024-06-28 thru 30, in 12 weeks!
- [JARL Ham Fair 2024](#) in Tokyo, Japan on 2024-08-24 and 25, in 23 weeks!

I'd love to receive input on what the **equivalent of these three is for Australia**, or any other comparable "national" Amateur Radio Conference, but I haven't been able to suss out *which* Australian Amateur Radio conference (there are many) is "the big one".

Paid Subscribers Update

My thanks to **Victoria Yanovich K8VSY** for becoming a Paid Subscriber to Zero Retries this past week! I've been following [Victoria's blog](#) for a while now, which I discovered on Mastodon.

My thanks to **Prefers to Remain Anonymous 25** for becoming a Paid Subscriber to Zero Retries this past week!

Financial support is a real vote of confidence for continuing to publish Zero Retries.

Ward Silver N0AX is 2024 Recipient of Hamvention Technical Achievement Award

It feels prescient that in **Zero Retries 0142** I recommended a Zero Retries Interesting video of Ward Silver N0AX's banquet talk at the 2015 ARRL and TAPR Digital Communications Conference (DCC) - [Ham Radio... Now What?](#)...

... and within days of that recommendation, Hamvention awarded N0AX its [2024 Technical Achievement Award](#):

For the past 15 years Ward has been the Lead Editor of the ARRL Handbook and the ARRL Antenna Book, and a primary author of all three ARRL License Manuals and study guides from 2004 until his retirement in 2023. He wrote the well-received "Grounding and Bonding for the Radio Amateur" (now in its 2nd edition) and "Ham Radio for Dummies" (now in its 4th edition). His monthly QST column, "Hands-On Radio" ran for 180 issues and has now been published in book format. The recent ARRL book, "Here to There: Radio Wave Propagation" includes his contributions including being its editor. He gives many online and in-person presentations and is a two-time recipient of the Bill Orr Technical Writing Award, as well.

An electrical engineer, he designed microprocessor-based products and medical devices for twenty years before beginning a second career as a teacher and writer. Licensed since 1972, he is a co-founder of the World Radiosport Team Championships, and was inducted into the CQ Contest Hall of Fame in 2015, with numerous top scores and records. He is President of the Yasm Foundation (yasm.org) and is also a board member of the HamSCI collaborative research group (hamsci.org). Ward's primary interests in amateur radio include radiosport, antenna design, and supporting his local emergency response team.

I worked with N0AX in 2023 to contribute a small portion of the 100th Anniversary of the ARRL Handbook, and it was evident that he was a highly skilled managing editor of that project.

I wasn't aware of the Hands-On Radio anthologies ([Volume 1 & 2](#), [Volume 3](#)) - I'll have to buy those for my collection of N0AX books.

Congratulations Ward! This recognition is richly deserved!

EastNET Quarterly Videoconference on 2024-03-14

I participated in the [EastNET](#) Quarterly videoconference this past week and it was *energizing* to listen to the discussion of not just an operating, and growing Amateur Radio heterogeneous (not just classic Amateur Radio Packet Radio) network, but that *other technologies* (that I've been discussing here in Zero Retries) were being actively considered and experimented with. The [agenda](#) was published on the [EastNET mailing list](#):

- [Hamgate](#) – The easy way to get yourself connected to the ampr.org (44 Net) network.
- [Meshtastic](#) – What is it and why do we care?
- [VARA](#) – What are our successes?
- BBS White pages – what the heck are they and why is it important?

- Updates on [Radio Relay International \(RRI\)](#).
- [New Packet Radio \(NPR\)](#) – What is it and what is it not.
- Status of your regional efforts, projects and general network connectivity.

There was also a bit of discussion about AREDN mesh networking, and I put in a brief plug for experimenting with VARA FM, not just VARA HF (though the primary use of VARA HF was not for networking per se, but moving messages regionally between Bulletin Board Systems. Kudos to the organizers for this interesting videoconference!

Nothing heard on FCC 16-239

No news yet from the FCC about amending the US Amateur Radio rules to remove bandwidth limits from the US Amateur Radio VHF / UHF bands. When that decision is finally made, it will probably warrant a special issue of Zero Retries.

New Junior Late Night Assistant Editor (In Training)

While Jack Stroh will remain Late Night Assistant Editor Emeritus, in preparing this issue, my grandkitten Schrödinger (Shrödy) “expressed some interest” in the preparation of Zero Retries.



Happy Friday from sunny and warm Portland, Oregon USA.

Steve N8GNJ

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What's new at Digital Library of Amateur Radio & Communications

By Kay Savetz K6KJN

Hello from Internet Archive's [Digital Library of Amateur Radio and Communications](#). I just ran the numbers: DLARC currently has 112,742 items for you to read, watch, and listen to. We've scanned more than 940,000 pages of books, magazines, journal issues, manuals, and radio catalogs. Other documents not scanned by Internet Archive (such as newsletters provided in PDF format by ham clubs) encompass more than 82,000 documents, 1.4 million pages. Audio items (including podcasts and radio shows) encompass 14,328 items: more than one year of audio material. 7,692 video items, which is now enough that it broke my “how long would it take to watch it all?” script.

Here's a peek into some of what we've added to DLARC in the past month.

It's a big month for radio magazines in the DLARC archive! We have added the complete run — 181 issues — of [VHF Communications](#), a magazine that was published quarterly from 1969 through 2013. It focused on the VHF, UHF, and microwave bands. It was spun off from UKW Berichte, a German radio magazine.

We also added 300+ issues of [Monitoring Times](#), a magazine that covered shortwave, longwave, amateur satellite, military communications, and more

obscure radio communications. Monitoring Times was published from 1982 through 2013, and DLARC has a majority of the issues for you to read, search, and download. According to the handy [DLARC Wantlist](#), we still need all the issues from 1982 through 1986, most of 1986 and 1987, and just a handful of issues from the 1990s. Let me know if you have these to share: I want to make this a complete collection.

DLARC also added 154 issues of [Mobile Radio Technology](#), a magazine devoted to land mobile radio, focusing on radio design, FCC and spectrum politics, and other topics related to the technology. Launched in 1983, the magazine was later renamed to Urgent Communications. Our collection hits its stride in 1992 — we still need most issues published from 1983 to 1991. As with VHF Communications and Monitoring Times, you can download them or view them online.

But wait, there's more! DLARC also added [154 issues of Circuit Cellar](#), a magazine for hardware hackers that spun off from BYTE magazine when BYTE was moving away from hardware projects. There's plenty of interesting radio communications projects in those pages. This was *supposed* to be a nearly complete collection, but FedEx apparently lost one of the two boxes of magazines on their way to the scanning center. So again, if you have any issues to donate that aren't one of [these 154](#), please let me know.

I mentioned in January that DLARC had acquired 370 issues of the [W5YI Report](#). If you've somehow managed to read all of those already, I have good news: now we're up to 462 issues. These new issues were donated to the library by the estate of Fred Laun, K3ZO. "America's Oldest Ham Radio Newsletter" was published from 1978 until 2003 by Fred Maia, W5YI. I really want to complete this collection. We still need the earliest years (volumes 1-5), most of 1992 (volume 14) and, well, [any issues that you don't see online yet](#).

Finally, we continue to build our collection of [Radio Fun](#), which was Wayne Green's tabloid-sized "beginner's guide to the exciting world of amateur radio." Published only for a couple of years in the mid-1990s, it was meant to be a bridge into the hobby for newbie hams. We're up to 30 issues scanned, with more in the pipeline. (I'm not sure what was the last issue: if there are issue numbers above #51, we still need those.)

Moving quickly from magazines to newsletters: DLARC has added 536 issues of the Rochester (New York) Amateur Radio Association ["RaRa Rag" newsletter](#) from 1973 to the present, 52 issues of Canton (Ohio) Amateur Radio Club ["Feedline" newsletter](#), 182 issues of the Amateur Radio Club of El Cajon (California) ["Counterpoise" newsletter](#), 102 issues of the Northern Kentucky Amateur Radio Club ["Feedline" newsletter](#), 152 issues of the Candlewood (Connecticut) Amateur Radio Association ["Capers" newsletter](#), and [EME technical reports from the long-defunct Crawford Hill VHF Club](#).

(You're not seeing double: yes, we added two newsletters called Feedline from different clubs. For those keeping score at home, there's also the Western Illinois Amateur Radio Club ["Feedline" newsletter](#), which DLARC added last year.)

Remember the Manuals Plus collection that I wrote about last month? At that time, there were 954 manuals. [Today, there are 2,450 manuals scanned and online](#) — and the scanning center still has one pallet of manuals to go. (This [Weston Model 1292 Bi-Polar Digital Panel Meter manual](#) is a contender for best cover.)

That's a whole lot of reading material. Let's move on for a moment to amateur radio conferences, starting with the TAPR Digital Communications Conference.

I've mentioned before that DLARC has [40 years of papers and presentations from TAPR conferences](#), including their Digital Communications Conference (DCC) and Computer Networking Conference. Now I'm thrilled to announce that we've added [audio recordings of DCC presentations spanning 1996 through 2001](#): 214 sessions in all!

These well-recorded sessions were found on TAPR Conference CD-ROMs as RealAudio files, an audio format so obsolete that it might as well be Sanskrit. I converted them to MP3 and carefully organized them. The audio fidelity isn't the highest — but a) it's better than SSB on 40 meters; b) it's a small miracle that these recorded presentations exist at all, so let's not quibble about sound quality. The recordings of these presentations can provide so much more detail than the PowerPoint decks and papers alone. From 1996, there's Keith Sproul WU2Z's talk about [WinAPRS](#), recorded not long after version 1.0 of that software was released; and Lyle Johnson WA7GXD's banquet speech about the ["Future of Amateur Radio."](#) (Did his predictions come true? Listen and decide for yourself.) In 1997, just a year after the print-your-own-driving-directions service [MapQuest.com](#) launched, Tom Clark W3IWI gave a talk called ["What is GPS? How does it work and why do I care?"](#)

(And, oops! While writing this I found ["DCC1996: Unknown session"](#) which was an unattributed audio file that apparently I forgot to dig into. A DLARC logo sticker goes to whoever tells me who it is and what it's about. Actually, it sounds like it may be multiple short talks.)

FOSDEM (Free and Open Source Software Developers' European Meeting) is an annual event for software developers held in Brussels since 2000. Talks at that conference run the gamut of topics including programming, security, and databases. Often, this con has a radio track: sometimes it's been called Free Software Radio, other times it's called Software-Defined Radio. By any name, FOSDEM's more than 130 [FOSDEM Radio Presentations](#) are now available in DLARC, complete with videos and, when available, slide decks. There are countless interesting talks such as 2018's ["Bring-your-own-radio hacking session"](#) and 2022's ["Emitting Hellschreiber from a Raspberry Pi GPIO."](#) (Today I learned that Hellschreiber is a morse-like graphical transmission of digital data reminiscent of fax over wireless used during the second world war by the German military.)

Internet Archive just launched "Lists", a new feature that any logged-in user can use to organize Internet Archive item into personal collections. For instance, you might create a list of your favorite radio books, or groups of items on related niche topics. Lists can be private (like a set of bookmarked items just for you) or public (to share the item collections you create with the world.) [Here's more information about Lists](#). I started a list called [Best of DLARC](#), highlighting some of the great resources in our radio library. It was a challenge to limit it to just a couple dozen items. What do you think should be part of that list?

Digital Library of Amateur Radio & Communications is funded by a grant from Amateur Radio Digital Communications ([ARDC](#)) to create a free digital library for the radio community, researchers, educators, and students. If have questions about the project or material to contribute, contact me at kay@archive.org.

Leave a comment

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Use of AI in Amateur Radio for Experimentation

By Steve Stroh N8GNJ

No, this isn't an article written with "help" from Artificial Intelligence (AI) / Machine Learning (ML); it's about **using AI/ML within radio technology** for better, more efficient radio communications.

AI/ML is much in the news of late, and a recent ZR > BEACON item about a Qualcomm chip for radio communications that embeds AI capabilities is just the beginning of increasing use of AI/ML in radio technology.

There was a recent presentation - **AI in Amateur Radio** ("I'm sorry, Dan. I'm afraid I can't do that") by Michelle Thompson W5NYV for [RATPAC](#), but I wasn't able to attend that videoconference and they have not yet posted the archived content. Thus none of this reflects what was discussed in that presentation.

Phil Karn KA9Q on Amateur Radio Experimentation in **Zero Retries 0142** was a precursor to this story.

Not Quite Realized Techniques for More Efficient Spectrum Use

None of what is described in this article is actually an implementation of AI/ML techniques. The techniques described here, and in the prior article, have been implemented / explored / theorized prior to the advent of AI/ML... but it's easy to imagine how much more powerful these techniques would be through the use of AI/ML, especially *now* that AI/ML can be embedded (don't require centralized, server farm processing such as OpenAI's ChatGPT and many other AI systems).

Technique - Television White Spaces (TVWS) Spectrum Sensing (Cognitive Radio)

More than two decades ago, when the demand for Broadband Internet Access was intense, and broadband Internet access infrastructure was just beginning, there were many disparate, competing methods of providing Broadband Internet Access. [In my writing](#), I foresaw that someone would try to make opportunistic use of the largely vacant television broadcast spectrum for Broadband Internet Access. That idea eventually became known as "Television Whitespace" - FCC-04-186.

In my [comments to the FCC](#) I promoted a "spectrum sensing" approach; basically that a "Television White Space" (TVWS) radio should periodically "listen" for a television transmission, and if one is received, then the TVWS radio should move off that television channel to avoid interfering with that television transmission. That approach became known "cognitive radio".

Ultimately the "sensing" approach wasn't chosen by the FCC because (in my opinion) it offered *too little "friction"* for an alternative use of "television broadcaster's" spectrum. [TVWS radios now exist](#), but are burdened by the requirement to use a complex "Mother, May I?" infrastructure to insure, to an *unreasonable* degree, that a WSR will not cause any *conceivable* interference to a television broadcast. As useful as White Spaces could have been, the technology never quite recovered from that limitation to be used widely for consumer Broadband Internet Access.

Although I didn't offer this observation in my FCC comments at that time, since then I have made the observation that *computers can make decisions about spectrum usage in microseconds*; humans make the same sorts of decisions in years, with regulations and laws that are obsolete by the time they're agreed to and committed to text.

Technique - Announcing Your Transmission Schedule, Then Focusing Transmissions

Being a [writer during the early days of the commercial Internet, specializing in Wireless Broadband Internet Access](#), was the best, er, scam of my career because companies with interesting wireless technologies wanted to talk to me so that I might write about their company and their products. Being an Amateur Radio Operator with a little bit of background in networking and computers, having companies wanting to tell me about their wireless technology was endless intellectual fun.

One of the most interesting technologies I was briefed on was a startup company that made outdoor microwave network systems that were "multipoint to multipoint" on the 6 GHz and other bands *that were licensed solely for point-to-point links*. Thus, multipoint to multipoint operation seems not to be compatible with those bands. But this company's systems had two interesting capabilities that made multipoint to multipoint feasible and legal. First, these systems used (very early, expensive) phased array techniques with a sector (either 90° or 120°) antenna. Within the sector, the phased array would focus in particular direction, transmission-by-transmission. Thus if a node X needed to communicate with node Y, both node X and Y would focus on that path. If node X needed to communicate with Node Z, both node X and Z would focus on *that* path. Thus, despite the sector antenna, effectively, these were point to point transmissions, thus compatible with the intended use of that band. To "keep it legal", point-to-point licenses were arranged for all possible link paths such as node X to node Y, node X to node Z, node Y to Node Z, etc.

I don't quite remember the particulars of the second feature - broadcast of transmission schedules, but approximately, the multipoint to multipoint technology allowed paths and frequencies to be reused very aggressively, even between competing networks. For example, if a path study between node X and node Z on frequency 1 showed that there might be interference to an existing licensed link, the second license probably wouldn't be granted. But if both networks used this company's systems, paths and frequencies could be "shared" because each unit would broadcast its "schedule" of *transmission time, frequency, and direction / path* - to all other units that were within its operating area. With that information being shared amongst all the units, all of the units that could "hear" each other could create a common, cooperative schedule of transmissions, frequencies, and paths so that different networks could reuse paths and frequencies without interfering with each other. While this wasn't Artificial Intelligence or Machine Learning, it was an example of the kind of substantive difference that AI / ML techniques could make in congested portions of spectrum, especially when there are competing users of that spectrum. The humans might not want to cooperate between themselves (preferring exclusive allocations of spectrum), but in such a system, the *radios* have no trouble cooperating amongst themselves.

The company was surprised that I understood the advantages of their new (to them) concept so well, and so quickly. That's because this wasn't the first time I had heard of such a technique.

Decentralized Channel Management in Scalable Multihop Spread-Spectrum Packet Radio Networks

I first heard of the technique of "broadcast your transmission schedule" in a talk at the 1998 Digital Communications Conference (DCC) Sunday Technical Seminar: [Packet Radio Networks with Millions or Billions of Stations](#). The presenter was Tim Shepard KD1KY, who told some of the story of his 1995 MIT Ph.D. thesis [Decentralized Channel Management in Scalable Multihop Spread-Spectrum Packet Radio Networks](#).

So I was looking for a thesis topic. And that's sometimes a hard thing. And that's sometimes why people take so long to get their graduate school, to find what are you going to do?

You only do that on thesis, and it's kind of a big deal. And part of the problems with finding a thesis topic is that I was being distracted by all sorts of things, including ham radio, which I was getting more and more involved in the ham radio club. And what they were doing was hidden transmitter hunting. And I was running around wasting time looking for a hidden transmitter that kept getting hidden in the Boston area.

And I was also getting distracted by other fantasies. I was having technical fantasies to build things and do neat things. And I was sort of in a computer science, more oriented graduate program. And one of the things that always frustrated me was the fact that I had to walk across campus to go back to freshman year.

I had a 300-bit per second dial-up in my room. I'd have to walk across campus to get the real useful connection to the computer in the net, which was a 9,600-bit per second 2480 VT100. But by the time I was in graduate school, I had the 9,600 bit per second modem in my room. But it wasn't useful because I'd walk across campus. And by then I had an office where I had a MicroVAX 2 running X-window system. And it was on the net. And on 10-megabit Ethernet, well hooked to the Internet.

And frustration... why can't I have the net at home? And so I'd always been scheming on how to do this. Actually, one of the buildings I lived in was the building which had the 10 Megabit microwave for the NEARNET, which was the Boston area internet. And actually, I lived on the 8th floor. And up on the 26th floor was all the equipment. And they had routers and everything. And there was actually fiber, only six feet from my room, where it was the trunk.

And it's like... and I still had to dial in with my 9600 bit per second. Frustration, frustration. This is a frustration I had, I think, a better part of a decade. And so then I moved. And I looked. And the building they had my office in, I could see many windows in that building. Not my own, but I could see many windows in that building out my window. I don't remember the exact distance. There's one or two kilometers. I ought to be able to do something.

And I started thinking free space optical links, which actually there are a few of those around. But of course, they were very expensive for a graduate student budget in those days. So I started having other fantasies.

Like maybe I could build a pair of radios. And actually, optics has a problem that you have to get lenses. And you have to line it up. And it doesn't work when it rains. So I started thinking about radio. The problem with radio is, well, you need a license.

Well, I already have a HAM license. But there's this content problem that you can't just go read all your email, because you never know what anybody has sent you. So you can't take responsibility for it. So I thought, well, I need something. And besides, I sort of wanted to be able to let my friends do this. And most of them didn't have licenses. And so what I wanted was a loophole.

So I actually went off and I sat down in the small law library at the business school at MIT. And I actually sat down and I started reading 47 CFR in general, and particularly 47 CFR 15, which is the place I expected I'd find a loophole. That's what people call Part 15. This is sort of what a lawyer's would call Part 10.

This is volume 47 of the Code of Federal Regulations, which are the regulations that are written by the bureaucrats, not the laws that are made by the legislative process. Anyway, this is with the Part 15 unlicensed authorization that I discovered. And this was probably late in 91. I'm reading along, looking at each of the things you can do in Part 15. And I'm like, wow, you can do a watt as long as your antenna gain is at most 6 dBi. So sort of an ERP of 4 watts in three different bands, the widest of which is 125 MHz wide.

But this regulation required that you use spread spectrum with at least 10 dB of processing gain in the receiver. Most people are ignoring this requirement that you actually demonstrate the system of 10 dB of processing gain in the receiver these days.

But anyway, sitting there reading the FCC regulations is like, what's the spread spectrum? And what's the processing gain? And I had sort of gone through the computer science curriculum, so I hadn't had all the modulation and that sort of theory.

So that sent me off studying, looking in the library. And I started thinking, oh, yeah, that's something I could do. And I started having fantasies of building up. Here's me. Here's the building I want to get to. I want that. And that'd be neat. And of course, any time you go to the trouble of spinning some boards and populating them, you don't build just two boards. You actually get a dozen boards made and maybe a prototype. And then you figure out how to really make them. And then you sell them to your friends.

The above was only the first 100 "[transcription snippets](#)" (of 2297) from Internet Archive's recording of that talk. From my fallible memory of the talk, after KD1KY began fantasizing about accessing the computer systems from his dorm or apartment via packet radio... he then began thinking about how such a system would be able to *scale* so that *everyone* could do so. From his Amateur Radio experience, he was well aware that collisions can quickly collapse a network into uselessness. Thus he pondered how could that the congestive collapse situation be avoided without resorting to rigid (unworkable) assignments of frequencies to individual users or groups, or an entirely new system that assigns time slots², etc.

The technique that KD1KY imagined and describes in his paper is that each node maintains a schedule when it will transmit, and then broadcasts that schedule. Each other node on the same frequency hears other node's "transmit schedule" transmissions and adjust their own transmission schedule accordingly. Thus, over time, all the nodes eventually settle into a reasonable schedule that minimizes collisions... *without requiring proscriptive coordination*. Such a scheme also has the advantage of a new node coming into the network can first listen to the existing node's "transmit schedules" and then attempt its own transmit schedule, and the other nodes accommodate the new node's need to transmit.

I've kept KD1KY's system in mind over the decades, and the technologies now available in Amateur Radio it's never seemed more opportune to apply such a technique. What's fascinating about this technique, applied to Amateur Radio, nearly three decades later, is that now we have a "universal receiver" in [ka9q-radio](#) - one receiver that can monitor all the "channels" on an Amateur Radio VHF / UHF band. That potentially providing a much improved technique than KD1KY imagined; if the ka9q-radio receiver "hears" that a particular channel has less use, the node can decide to move its transmissions to the lesser-used channel, listen, then announce its presence with a "transmit schedule" transmission. What's different about ka9q-radio versus scanning or periodic listening is that it can receive all channels, *simultaneously*, providing a *comprehensive* and *realtime* "map" of users on, and usage of each channel.

Of course, it requires quite a bit of compute power to sort through the various transmissions and rationalize them into a usable, actionable transmission schedule that will efficiently, reliably *get your data to the intended recipient*, but now we have ample, cheap compute power such as [Raspberry Pi 5](#) that we can afford, both in resources and cost (we can dedicate it to the task).

Since 1995, we also have better modems for more efficient, more reliable data communications in a typical 20 kHz VHF / UHF channel than 1200 baud AFSK circa 1995, and we may even be able to use wider channels ([hint](#), [hint FCC](#)...), but that's a discussion for a future article.

If We Can Receive *Everywhere*... Then We Can Transmit *Anywhere*

... and still communicate.

This is one of the most profound insights I've gained from thinking about ka9q-radio:

For digital communications (voice or data), it no longer matters where you transmit (what frequency / channel) because we can now receive everywhere (any frequency / channel)... and "find" each other with digital identifiers.

A radio using ka9q-radio techniques can monitor every channel, simultaneously, monitoring for a particular callsign or other identifier.

- Packet Radio had this neat feature called the LLIST - callsigns you didn't want your system interacting with. Just add a packet radio system's callsign to your system's LLIST and your system just ignores the other system.
- Every DMR radio requires a unique (per network) "Radio ID" be programmed. For use of DMR on Amateur Radio, the Radio ID [is "translatable" to an Amateur Radio callsign](#).
- D-Star, System Fusion, and M17 all use Amateur Radio callsigns as the Radio ID.

Once a radio is transmitting a unique *digital* identifier, all kinds of things are possible. Like LLIST, some DMR repeater owners have made use of Radio ID to exclude (people they consider) problematic individuals by "locking out" individual radio IDs. Once "locked out", they're not even allowed to transmit into the repeater. They can try, but the repeater doesn't "authorize" them to transmit.

But a more benign, better use of a radio's digital identifier is a scenario like wanting to have conversations with a friend, and your radio is "ka9q-radio capable". Thus, you set your radio for "I want to hear from Betsy whenever she transmits on whatever repeater system" and your system will just notify you "Betsy is transmitting". Hanging out on a specific frequency or repeater will be "quaint" in comparison.

The digital identifier doesn't have to be a radio / individual; it can be a group identification such as anyone in a specific Amateur Radio club, or even a specific "net", or nearly anything.

Summary - We Are *Just Getting Started* With Data Experimentation on Amateur Radio

Phil Karn's KA9Q observation in the previous story, to a non Amateur Radio audience, that Amateur Radio is a *great* place for experimentation in radio technology has *never* been more true than it is in the 2020s.

- Amateur Radio is the ultimate "[greenfield](#)" environment for experimentation with new radio technologies.
- There is little rigid segmentation of Amateur Radio bands, especially our VHF / UHF bands; there are just a few areas that are reserved for special purposes such as space communications or low power operation.
- We now have reasonably-priced and reasonably capable "universal software radios".
- We now have reasonably priced and reasonably powerful compute power that can be dedicated to "radio" use.
- More than ever, the new Amateur Radio are curious techies with interesting ideas who are used to experimenting with ideas about communications in software. Their lack of knowledge about "well, this is the way we've always done it" is actually an advantage for new radio technology. They just need to learn the "radio bits", and the (US) Technician license is a good entry into Amateur Radio.
- There's no shortage of interesting ideas, projects, and technologies to apply. With Software Defined Radio technology, experimentation in radio technology can easily be conducted mostly in the software realm, rather than the hardware realm, or even having to build much new radio frequency hardware.

There just isn't much that we can't do in this new era.

We just have to want to try to do some of this rich experimentation in radio technology!

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The Biggest Issue of "The Zombie Apocalypse" - No Grid Power

By Steve Stroh N8GNJ

This isn't quite Amateur Radio... but it's adjacent to Amateur Radio because our radios don't work without power. Battery backup can keep the radios operating for a while, but most of us use grid power to charge our batteries with perhaps a bit of solar, but longer term unless we have a big solar system to carry our base load, we're in trouble without grid power.

[This was written by Jeff Davis KE9V](#), almost in passing, as a cautionary tale for his new series *The Zombie Apocalypse* - see ZR > BEACON for the details.

The aging power grid in the US will quickly become a major problem in any SHTF scenario that can be conjured. The cost to replace it is enormous and I'm not even certain with \$34 trillion of debt the US could afford to revamp the entire power grid system even if it really, really wanted to.

Even if the grid doesn't technically fail, control of it may fall into the hands of jack-booted thugs who could benefit from pulling the plug on select regions. However that turns out, assuming that power will always be available is a terrible assumption. And the lack of basic power impacts everything...

In 2005 Central Indiana experienced a once in a lifetime ice storm. Power lines were down everywhere and power wouldn't be restored at my house for eight long, agonizing days. But that was the least of our problems during the first 72 hours. With power off the internet was down. Gas stations had fuel and kerosene in their tanks but without electricity, no way to pump it out of the ground. Portable generators got those pumps running by the 3rd day of the crisis, but with no internet connectivity anywhere in town gas stations and other retail outlets (grocery stores) couldn't take a credit card. And since power was down on a broad scale, ATM's were out of service. You got a suitcase full of cash at home and you might do okay, you got ten bucks in your pocket, and you were effectively "broke".

I'm an engineer, I know how a lot of things work. But that ice storm experience gave me a different perspective about the way things work and believe me, we've built most things wrong. I mean, unless you believe in magic, miracles, and a lot of good luck, then just over the hilltop lies an ominous future.

Access to power is the number one concern for surviving the zombie apocalypse. You may disagree, but power generation needs to be very high on your list. Remember, if the power and internet are out broadly, no one will be able to let QRZ know you've become a Silent Key. Best you solve the power problem first, long before worrying about stockpiling ammo and MRE's.

Sometimes you just read something that "smacks you upside the head" and causes you to say, "*Damn, he's right!*".

As an example, my wife and I have been dithering about adding "infrastructure" solar + battery to our new (to us) house, but complicating that decision is that we may decide to relocate in a few years, and "solar" hasn't proven to be a durable investment when selling a home, at least not to the point of fully recovering the investment; I'm not going to realize a \$30k+ increase in sale price to recover my cost of installing of solar + battery.

Complicating decisions about adding infrastructure solar + battery, there are many ways to do it *wrong* - YouTube offers a number of fabulous studies in poor solar installations, including poor components, poor installation, sloppy integration of components, sloppy wiring, and many other issues. From my perspective, one of the worst mistakes (in this era, now that "household" batteries are actually practical) is to add solar but no battery ("Grid-Tie" solar). Grid-Tie solar seems to me to be largely a feel-good exercise that saves some money on power bills. With Grid-Tie solar, when the grid goes down, unless you've made very specific (out of the ordinary) provisions for your solar system to provide power to your house in the absence of grid power... *your solar power goes offline with the grid*. Not to mention, no sunshine, no power.

~~Another mistake would be, at least from one review I read, is to use Tesla's Powerwall products. Powerwall includes a remote monitoring capability, and the damning review reported that after his Tesla solar panel system + Powerwall "couldn't phone home" for a period (the cell system was down in a widespread power outage), the Powerwall shut itself off solely because it couldn't be remotely monitored.~~

Update - Per a comment from Steven Monsey apparently this is old information. I could not find any confirmation of my statement.

My late *Editor Rotundus* Jack Rickard (of [Boardwatch Magazine](#) fame) found a new calling after Boardwatch in converting gas vehicles to electric, and later "non mainstream" solar power systems, including repurposing battery packs salvaged from electric vehicles, for stationary use. Rickard proposed a concept for home solar systems called "[Selfish Solar](#)" where your solar power system was mostly an island, but could connect, opportunistically, to the grid. Or not, depending on circumstances of the moment - under *your* control. Thus, with that great, prescient advice, when / if I do pull the trigger on infrastructure solar + battery, *I will be very careful* to specify to the designer of the system that my primary requirement is that the system to be completely independent to the state of the grid connection. If the grid is available, great. If not, my solar + battery system can carry the critical loads of the household (and at least my prioritized Amateur Radio equipment)... with no "Mother, May I?" nonsense like the Tesla Powerwall requires.

An interesting middle ground in household battery backup, that seems to be gaining considerable momentum, is large "semi stationary" charger / battery / inverter systems such as the [EcoFlow DELTA Pro Ultra](#) and the [Anker SOLIX F3800](#), and I'm sure others in the same power class. All of these are around \$5,000, accept solar panel power directly (built in solar charge controller), and can plug into any pre-wired "generator" panel and have front panel outlets. The newest ones can output 2 phase 240 volts so they're plug compatible with large whole house generators and electrical panels set up for use with generators. Even better than generators, they can operate as a "many circuit uninterruptible power supply" if they are set up with a charging connection to grid power. You can just leave the "generator panel" engaged for full time power continuation. Some YouTubers are even setting up their breaker panels *themselves* to wire these units in. Such Do-It-Yourself electrical work seems to be a gray area because the battery unit isn't "permanently installed". The bonus of these units is that if you move (like we're likely to do), you can take it with you. What seems to have made these units popular and cost-effective is that China is making more batteries than their domestic, and automotive markets can absorb, thus these units keep getting more capable or cheaper nearly by the month.

I think Jack Rickard would be happy to see the emergence of these units as a disruptive element for the home energy / solar market. They might not ride out an entire eight days of KE9V's 2005 "no grid power" nightmare, just on the battery. Or, they *might* considering that you can just keep adding battery modules to increase the battery capacity. One of these units might be cheap insurance, along with a few solar panels to give yourself some power input other than a gasoline generator.

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ZR > BEACON

By Steve Stroh N8GNJ

Short mentions of Zero Retries Interesting items.

[The Zombie Apocalypse Series by Jeff Davis KE9V](#)

In the next several posts, I want to explore the feasibility for radio communication during an actual SHTF situation. I'm not talking about a tornado or hurricane event. Ham radio operators are already well-equipped to help out in those kinds of transitory situations and newspaper headlines point this out daily. What I want to discuss is a zombie apocalypse. You know, a full-scale military invasion by some enemy, or perhaps worse, all-out cyber warfare. An EMP event or another global pandemic. Etc.

[Episodes 2, 3, and 4](#) have dropped, and this series is *definitely* going to be interesting. Pseudostaffer Jeff Davis KE9V is a proven, gifted storyteller, though he's unsentimental about his past projects like the stellar audio series [Cornbread Road](#) (no longer generally available online).

[New ka9q-radio Mailing List](#)

Description: *Users of ka9q-radio and related software*

This is a good place to ask questions and generally learn about using the ka9q-radio software. It's a Google Groups list, and you'll have to request permission to join the list.

[SigintOS Version 2.0 Community Edition Released](#)

From RTL-SDR.com:

[SigintOS](#) is an Ubuntu based distribution with a number of built in signal intelligence applications for software defined radios such as the RTL-SDR and TX capable SDRs like the HackRF, bladeRF and USRP radios.

The OS has a built in launcher UI that helps to automatically launch and set up parameters for various programs and GNU Radio scripts that are commonly used. Examples include an FM transmitter, GPS transmitter, GSM base station searcher, IMSI catcher, LTE base station searcher, LTE decoder and a jammer.

Recently the team behind [SigintOS have released version 2.0 Community Edition](#). The team write on their release page:

About Community Edition

SigintOS 2.0 Community Edition; It was developed to provide a much better experience to its users. With a new interface, more stable and powerful infrastructure and development environment, it allows users to develop new tools in addition to existing tools.

Developing Signal Intelligence tools is now much easier with SigintOS™

It is now much easier to develop your own tools with SigintOS™, which contains the world's most famous and free signal processing and communication software. You can develop them effortlessly with tools such as QT and KDevelop.

Wouldn't it be cool if there was a SigintOS for *Amateur Radio* modes?

[LimeNET Micro 2.0](#)

From Crowd Supply:

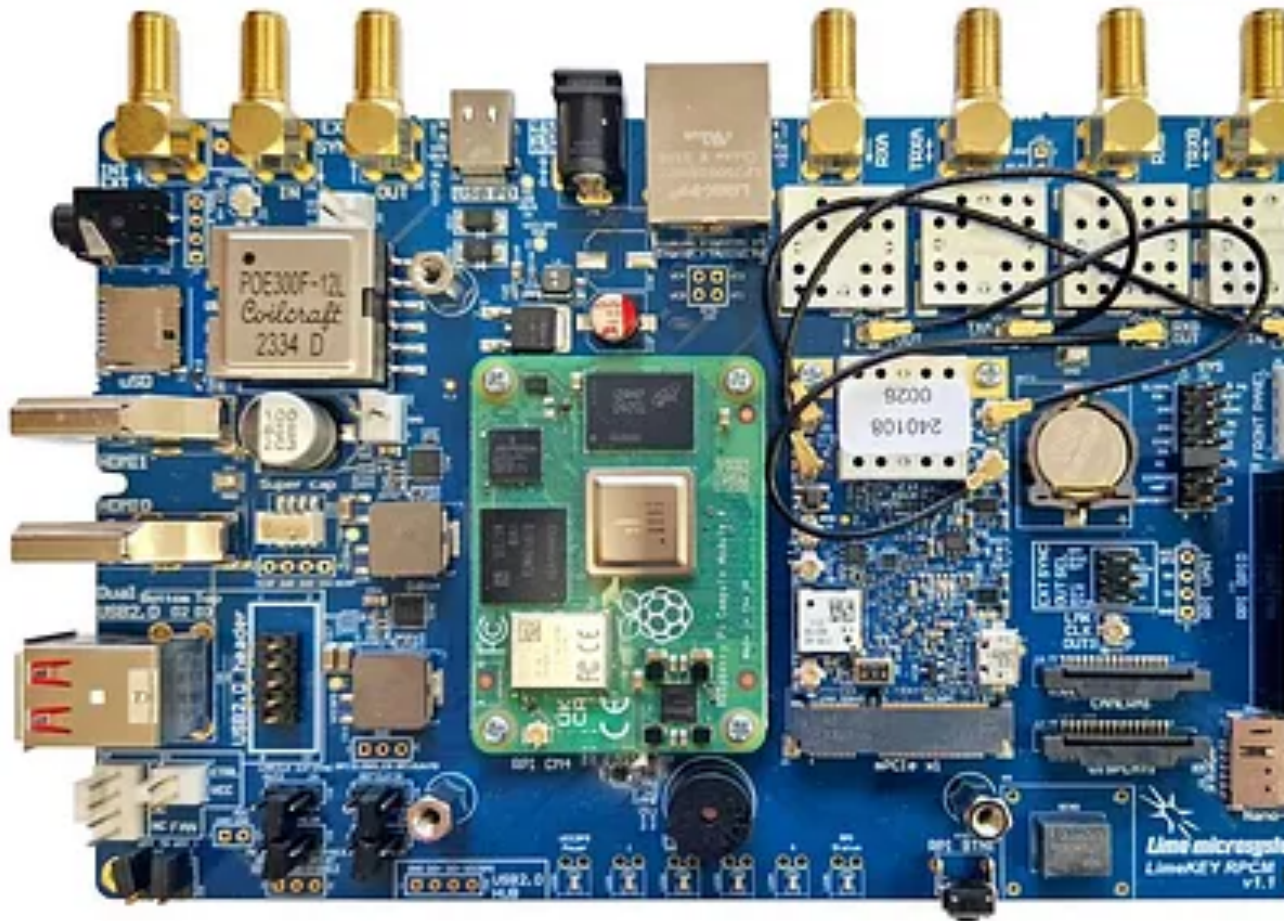


Image courtesy of Lime Microsystems / Crowd Supply

A radio frontend carrier board for LimeSDR XTRX and the Raspberry Pi CM4

LimeNET Micro 2.0 is a modular radio platform that leverages the Raspberry Pi CM4 and LimeSDR XTRX for their respective computing and RF features. It is significantly more versatile than [the previous version of LimeNET Micro](#), which was limited by a slower (CM3) compute module and an integrated SISO radio. LimeNET Micro 2.0 is an ideal tool for a wide range of wireless applications ranging from experimental deployments to real-world enterprise installations.

Features & Specifications

LimeNET Micro 2.0 provides access to all of the connectivity and functionality of the CM4 and LimeSDR XTRX boards at its heart. That includes:

- USB 2.0 Type-C socket (boot and power delivery)
- Dual USB 2.0 Type-A sockets (downstream ports) or a front-panel USB 2.0 header (unpopulated)
- Gigabit Ethernet jack with PoE support
- Mini PCIe x1 Gen 2 (5 Gbps)
- 2x HDMI 2.0 receptacles (up to 4K 60P supported)
- 2x 15-pin FPC connectors for MIPI DSI display and CSI camera
- 3.5 mm, 4-pin jack for analog audio and composite video
- MicroSD card slot
- NanoSIM socket
- Coaxial RF (4x SMA female + 4x U.FL female) connectors for RF frontend
- Coaxial pass-through U.FL to external SMA connector
- 20-pin Raspberry Pi CM4 GPIO header (3.3 V)

- 14-pin Raspberry Pi CM4 SYS header
- 5-pin front display connector (power, I²C, button)
- Raspberry Pi CM4 UART0 header (unpopulated)
- 2-pin and 4-pin fan connector at 5 V (default), 3.3 V, or VCC_INT voltage

The new frontend module (FEM) provides higher output power using Qorvo drivers and amplifiers for a more comprehensive coverage range while keeping the frequency flexibility of the original LimeNET Micro. It also features low noise amplifiers (LNAs) and SPDT switches that provide for both FDD and TDD modes of operation.

We will reveal more new features, enhancements, and applications of LimeNET Micro 2.0 before and during the campaign.

This will be an interesting project to follow. The use cases for the previous version of the LimeNET Micro include:

- Inexpensive enterprise and personal networks
- Rural, autonomous, and resilient networks
- Universal IoT communications hubs
- Rapid deployment infrastructure for emergency response
- Remote radio solutions for amateur radio and radio astronomy
- Integration into application-specific RF appliances
- Radio spectrum survey
- Passive wireless geolocation
- PHY and security research
- RF-aware robotics

My thanks to Zero Retries subscriber ReadyKilowatt for the pointer to this project.

[\(In\)Security in Amateur Radio](#)

Ben Kuhn KU0HN:

As someone who works in information security, I do threat modeling every day, I can't help but notice that the state of security in amateur radio, both radio systems and internet-based systems used by amateur operators is a total disaster. Some of this is the result of the law—it is not permissible to obscure the meaning of a digital transmission—and some of it is of a more practical nature. Hams have traditionally assisted in emergency communications and disaster relief where minimal equipment may be available so a less secure system is still accessible without the aid of a computer.

Here are some examples of how authentication is handled on a variety of systems.

- Many repeaters can be remotely managed by a series of DTMF tones.
- Packet TNCs can be managed by entering the sysop command and a subset of a preconfigured password. For example, on a Kantronics KAM XL, the process looks like this: "Upon receiving the SYSOP command from a remote user, the PBBS will return three lines of five numbers each. These numbers indicate the character positions in the RTEXT command."
- Winlink will prompt a user connecting with a terminal or via APRSLink for three specific characters in your password, and any 3 other characters in the password from any position.
- AREDN nodes use a standard username and password over an unencrypted HTTP connection.

While KU0HN's points are valid, in mild ~~defense~~ *explanation* of the Kantronics KAM XL and repeaters of long standing, *they're old and not designed with any significant security in mind*. If you pop the cover of a newly purchased KAM XL, you'll see that its design is essentially unchanged from a KAM XL from decades ago. The majority of repeater controllers are of a similar vintage.

This is not to say that the managers (trustees) of "public" systems shouldn't do better... they should.

I wanted to include this item in this week's Zero Retries, and that didn't give me enough time to do full due diligence to back the points below, *so I could easily be wrong*. But, as I understand the "encryption" status quo in Amateur Radio...

- Encryption of a communication in Amateur Radio is currently only allowed for managing satellites and for remote control of hobby vehicles (remote control airplanes, and in recent years, drones).
- *Authentication* of the identity of someone transmitting is *not specifically disallowed*, thus legal. *Method* of authentication is not addressed in the Amateur Radio regulations, thus left to the ingenuity of the sender. I believe this is discussed at length in the "Hailing Channel" video discussed in **Zero Retries 0142**.
- *Novel* (to someone) modulation methods are *not* encryption, as long as you're prepared to prove that the modulation's *intent* is not "obfuscation" of the content, and that the content *can* be recovered using a typical example of the system (or published protocol, or algorithm). For example, using a

pair of (unencrypted) P25 radios to communicate isn't encryption, nor is using an uncommon data format such as the data capability embedded in DVB-T video.

- A related area of data communications that can be mistaken for encryption is data compression, but, again, as long as you're prepared to prove that the modulation's intent is not "obfuscation" of the content, and that the content can be recovered using a typical example of the system (or published protocol, or algorithm).

Encryption is one of the issues that are coming up repeatedly when techies encounter Amateur Radio, especially when discussing the potential use of Amateur Radio for emergency communications. One of the most valid points is that encryption is perfectly acceptable (and is the default of many systems) operating in license-exempt spectrum such as 2.4 and 5 GHz... so why should an Amateur Radio system, when providing emergency communications, be encumbered by not being allowed to use encryption?

It is an issue, and I've been told that there are some discussions underway to potentially work substantively on this issue... but nothing public yet.

I think KU0HN's proposal has a lot of merit and could be a reasonable next step:

Currently § 97.207(b) regarding space stations reads: "Space telemetry transmissions may consist of specially coded messages intended to facilitate communications or related to the function of the spacecraft." A similar section should be added to the regulation of Repeater Stations, Amateur Stations under Telecommand, Message Forwarding Systems, and Automatically Controlled Digital Stations to read "Transmissions may consist of specially coded messages intended to facilitate communications or related to the function of the station." This simple change would permit the safe and secure remote management of stations without violating the open spirit of amateur radio.

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Join the *Fun* on Amateur Radio

If you're not yet licensed as an Amateur Radio Operator, and would like to join the fun by *literally having a license to experiment with radio technology*, check out

Join the Fun on Amateur Radio for some pointers.

Zero Retries Frequently Asked Questions (FAQs) — In development 2023-02.

Closing the Channel

In its mission to highlight technological innovation in Amateur Radio, promote Amateur Radio to techies as a literal license to experiment with radio technology, and make Amateur Radio more relevant to society in the 2020s and beyond, Zero Retries is published via email and web, and is available to everyone at no cost. Zero Retries is proud *not to participate* in the Amateur Radio Publishing Industrial Complex, which hides Amateur Radio content behind paywalls.

My ongoing *Thanks* to:

- Tina Stroh KD7WSF for, well, *everything*!
- **Founding Members who generously support Zero Retries financially:**
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- If you'd like to financially support Zero Retries, becoming a paid subscriber is *greatly* appreciated and helps offset expenses incurred in publishing Zero Retries. Paid subscriptions for Zero Retries are *entirely optional*, as explained in this special issue of ZR:
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- [Dan Romanchik KB6NU](#) mentions "Zero Retries Interesting" topics so regularly on his blog (that I otherwise wouldn't know about) that I've

bestowed on him the honorific of Pseudostaffer.

- [Jeff Davis KE9V](#) also mentions “Zero Retries Interesting” topics so regularly on his blog (that I otherwise wouldn’t know about) that I’ve bestowed on him the honorific of Pseudostaffer.
- [Amateur Radio Weekly](#) by Cale Mooth K4HCK is a weekly anthology of links to interesting Amateur Radio stories.
- [Experimental Radio News](#) by Bennet Z. Kobb AK4AV discusses (in detail) Experimental (Part 5) licenses issued by the US FCC. It’s a *must-read-now* for me!
- [RTL-SDR Blog](#) - *Excellent* coverage of Software Defined Radio units.
- [TAPR Packet Status Register](#) has been published continuously since 1982.
- Other Substack Amateur Radio newsletters recommended by Zero Retries.

These YouTube channels regularly feature Zero Retries Interesting content:

- [HB9BLA Wireless](#) by Andreas Spiess HB9BLA
- [KM6LYW Radio](#) by Craig Lamparter KM6LYW (home of the [DigiPi project](#))
- [Modern Ham](#) by Billy Penley KN4MKB
- [Tech Minds](#) by Matthew Miller M0DQW

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Email issues of Zero Retries are “instrumented” by [Substack](#) to gather basic statistics about opens, clicking links, etc.

More bits from Steve Stroh N8GNJ:

- [SuperPacket blog](#) — *Discussing new generations of Amateur Radio Data Communications — beyond Packet Radio (a precursor to Zero Retries)*
- [N8GNJ blog](#) — *Amateur Radio Station N8GNJ and the mad science experiments at N8GNJ Labs — Bellingham, Washington, USA*

Thanks for reading!

Steve Stroh N8GNJ / WRPS598 (He / Him / His)

These bits were handcrafted (by a mere human, not an Artificial Intelligence bot) in beautiful Bellingham ([The City of Subdued Excitement](#)), Washington, USA, and linked to the Internet via [Starlink Satellite Internet Access](#).

2024-03-15

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1

This is the same speech that I highlighted in Zero Retries 0037 - Banquet Speech by Lyle Johnson WA7GXD (now KK7P).

2

Again, from fallible memory, there was at least one “assign time slots” packet radio system that was tried in Amateur Radio... I just don’t remember which one it was.